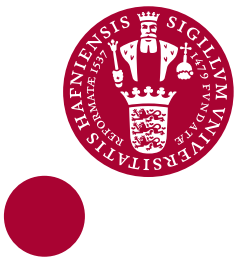

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Abstract
Danish farmers have been far less interested in agri-environmental subsidy schemes than anticipated. We use choice experiments to estimate 486 Danish farmers' preferences for a number of policy relevant scheme-characteristics. Subsidy schemes for pesticide free buffer zones along hedgerows are used as a case. A random parameter logit framework is applied. By quantifying farmers' preferences, we are able to assess the relative importance of individual scheme-characteristics. Our results indicate that overall contract terms (length and flexibility) are more important to farmers than practical management restrictions (choice of buffer zone width, using fertilizer, and reduced administrative burden). As a novelty, the administrative burden is captured by estimating how farmers value costless assistance to the actual application. For example, our model estimates indicate that an average farmer is willing to give up 120 Euros per hectare per year for changing a 5 year contract to a one year contract. However, whether a shorter contract is preferable from a societal point of view still depends on the environmental costs of reducing the contract length.

1. Background

Denmark has a long tradition of regulating the agricultural use of approved pesticides. The instruments have been a combination of pesticide taxes and voluntary measures such as subsidy schemes for pesticide free production, general information campaigns, subsidised advisory services at farm level of how to reduce pesticides use, subsidised pesticide reducing decision support systems, and publicly financed research in pest management. Particularly agri-environmental subsidy schemes (AES) have been widely used as they are encouraged by the Rural Development Fund under the present EU Common Agricultural Policy. However, the limited uptake of AES among farmers has increased interest in identifying factors that determine farmers' interest in AES. See among others Christensen et al. (2007) and Pedersen et al. (2007) for evaluations of Danish subsidy schemes for reducing pesticide use and Falconer (2000), Wynn et al.(2001), Siebert et al. (2006), DeFrancesco et al. (2007), Ruto & Garrod (2009), Ducos et al. (2009), Espinosa-Goded (2010) for investigations of AES in general.

Danish farmers successfully decreased their pesticide use from around 7000 tonnes in 1981 to around 4000 tonnes of active ingredients in 2008 (Environmental Protection Agency, 2009). However, a large part of this development has been driven by the introduction of more effective pesticides per weight unit and as a consequence the pressure on the environment has not decreased at the same rate as the volume of pesticides. In order to obtain a better measure of environmental effects, the so-called treatment frequency index (TFI) was introduced and is now the main Danish indicator of the consumption of approved pesticides[2]. Denmark's first Pesticide Action Plan was introduced in 1986, where the TFI was getting close to 3 aiming at reducing

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[2] The TFI represents the number of pesticide applications in the cultivated areas (calculated from the traded amount of pesticides that year), provided that a fixed standard dose is used. Uncultivated fallow fields, organically cultivated fields and constant grass fields are not defined as cultivated fields and therefore these types of fields are held out of the TFI calculation (Freier & Boller 2009, p.442)

TFI by 50 pct. (Freier & Boller 2009, p.442; Environmental Protection Agency 2009). The latest Pesticide Action Plan for the years underlined that the new goal was to reach a TFI of 1.7 at the end of 2009 as proposed by the Bichel Committee (Ministry of Environment & Ministry of Food, Agriculture and Fisheries 2003). However, the TFI has increased substantially since 2003 (Table 1).

Table 1. Development in the Danish pesticide use from 1997 to 2008 (measured as TFI)

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
TFI	2,63	2,40	2,45	2,07	2,19	2,10	2,33	2,39	2,49	2,52	2,51	3,16

Source: Environmental Protection Agency (2000; 2003; 2006; 2009)

Evaluations of the effectiveness of the pesticide plans (and AES in general) point to multiple explanations of what went wrong. One line of argument suggests that farming conditions have changed (changed input/output prices, more aggressive pest attacks, etc.) and as a consequence, the economic incentives have not been high enough to induce farmers to change behaviour. For the Danish case, these arguments apply to the insufficient effect of the pesticide taxes as well as to the sparse interest among farmers in signing up for subsidy schemes for pesticide-free production (Economic Council, 2010). Another line of arguments suggests that transactions costs serve as barriers such that farmers' perceived costs of complying with restrictions in a voluntary agreement exceed their costs of production loss (Falconer 2000). Mettepenningen et al. (2009) estimated private transaction costs (defined as costs that are not related to changed profits) for European farmers as 14 % of total AES-related costs which is 'considerably higher than indicated by previous research' (p. 663) and that ways to reduce these transaction costs should be investigated in order to increase AES uptake. A particular motivation for research in private transaction costs is that additional 20 % payments in AES under the CAP are based on the condition that they are documented as transaction costs. A third line of arguments has recently emerged suggesting that farmers do not only optimize in economic terms but are also driven by other motives such as professional pride in high yield etc. (Nielsen, 2009; Burton et al. 2008; Mettepenningen et al. 2007; Gasson 1973). Hence, there might be barriers in addition to the size of the size of the subsidy and to what extent private transaction costs are compensated that need to be overcome before participation rates can increase.

Basically, participation barriers can be addressed from two different angles. One solution is to provide sufficiently attractive 'entrance-values´. However, one of the problems with using subsidy schemes is that national budgets for environmental purposes are limited. Another problem is that, at the same time as the use of AES is encouraged by EU regulation – it is also restricted because of the 20 % ceiling on transactions costs. A third problem with increasing subsidy schemes is that it might not even affect the attractiveness of the schemes for farmers who to a large extent are motivated by non-economic values. Hence, a solution to increasing farmers' participation is not simply to increase subsidies. An alternative solution is to reduce transaction costs or non-economic barriers instead. Increasing interest has been shown towards understanding the determinants of when AES become a success – and when they do not. Several sociological studies have focused on identifying factors that affect farmers' propensity to participate in AES. These studies indicate that contract specific factors such as flexibility in contract specifications and information level are important (Wynn et al. 2001) just as shorter contracts are typically preferred to longer. Also Farmer factors such as age, education, farm size and financial situation (Siebert et al. 2006 provides an overview) just as having a social network that is positive towards subsidy schemes have also been found to have a significant effect on participation rates (ref).

The main purpose of the present paper is to estimate farmers' preferences for a number of policy relevant subsidy scheme characteristic and thereby place a monetary value on farmers' potential barriers for reducing pesticide use. The methodological approach taken in the present study is particularly inspired by Ruto & Garrod (2009). We conduct a choice experiment in order to elicit Danish farmers' preferences for subsidy schemes for pesticide free buffer zones along hedgerows. The intentions are that the results of our case study provide input to solving the ongoing problems of fulfilling the goals in Danish pesticide regulation. The novelty of our study lies in including increased use of farm extension service as a means to reduce

transaction costs. The case and the statistical method employed will be presented below, followed by the empirical analyses that lead to results that are discussed and concluded upon.

2. The choice experiment approach

2.1 Earlier studies

For decades, economic valuation methods have been used to elicit consumer preferences within marketing and transport economics. Also within environmental economics, a large number of studies on how consumers value the environmental benefits of various policy initiatives have been conducted but studies that seek to use the same techniques to elicit farmer preferences for various policy initiatives have only recently entered the scene. The studies have typically been a reaction to a knowledge gap concerning farmers' preferences towards AES. Indeed, these few studies provide promising new ways to force the farmers to rank their preferences for competing goals (such as for example, flexibility in farm management versus obtaining subsidies for undertaking specific changes in production).

Vanslembrouck et al. (2003) carried out a contingent valuation study on Belgian farmers' preferences for increasing landscape values. They found a group of farmers who were simply not interested in participating in a voluntary agreement (even though they could set the price themselves), that farmers were more reluctant to participate if they did not understand the environmental benefits involved, that buffer zones signalled sloppy farm management, and that many farmers prefer low-involvement agreements (even though the payments were also lower). Bateman et al. (1996) used contingent valuation to assess 19 farmers' preferences for converting farm land to forest. Using a logit model, Wynn et al. (2001) found that flexibility was important for farmers' decisions to participate in AES.

Ruto & Garrod (2009) used a choice experiment approach to investigate the role that scheme design can have on encouraging farmers to participate in AES. Their study involves 10 European countries – not including Denmark. Ruto & Garrod (2009) investigate farmer preferences for 4 specific scheme characteristics: Contract length (5, 10, 20 years), flexibility of what areas of the farm are entered into the scheme (yes, no), flexibility over undertaking some of the measures required under the scheme? (Yes, No), average time spent on paperwork/administration (less than 2 hours per week, 2-5 hours per week or more than 5 hours per week). All four scheme attributes were significant determinants of farmers' decisions to participate in AES. Interacting farm factors with contract length indicated that age, education, successor, rent and finance are negatively related to contract length whereas environmental concern and farm size were positively related to contract length. In addition, choice experiments were used by Birol (2006) to investigate Hungarian farmers' interest in home gardens. Using choice experiments, Epinosa-Goded (2009) found that Spanish farmers where more willing to participate in AES when restrictions on farm management were small and that fixed payment could substantially reduce overall payments. Also Ducos et al. (2009) used choice experiments and found that fixed transaction costs were a significant barrier to farmers' interest in AES – particularly for small farms.

2.2 Method description

The underlying assumption in estimating farmers' valuation of scheme attributes is that the farmers' choice of subsidy scheme depends on the specific requirements of the subsidy schemes (including the subsidy payments). Hence, the underlying theory of CE is based on Lancaster's Consumer Theory (LCT) (Lancaster 1966) and random utility theory (Gravelle & Rees 1992, Luce 1959, McFadden 1974). According to Lancaster, the (indirect) utility V_{ij} that individual i achieves from good j is the sum of the utilities obtained from each of the K characteristics s_{kij} where $k= 1, 2, \ldots, K)$. We assume that the utility V_{ij} is an additive function of attributes and can be written as follows:

$$V_{ij} = \beta_{1i} s_{1ij} + \beta_{2i} s_{2ij} + \ldots\ldots\ldots + \beta_{Ki} s_{Kij} \qquad (1)$$

Random utility theory is based on the assumption that individuals make choices according to a deterministic part along with some degree of randomness. Allowing U_{ij} to represent the random utility that individual i places on alternative j, V_{ij} now represents the deterministic component of the utility function and ε_{ij} is a random variable that captures the unsystematic and unobserved random element of individual i's choice (Hanley *et al.* 2002, Holmes & Adamowicz 2003). We will assume throughout the paper that the error terms are independent Gumbel distributions. An alternative specific constant (ASC_i) has been included which captures the (systematic) utility of omitted variables. The ASC is modelled as a dummy that takes the value 1 if one of the two hypothetical alternatives is chosen and 0 if the status quo is chosen. Hence, the random utility U_{ij} can be represented as follows:

$$U_{ij} = \beta_{ASCi} ASC_i + \beta_{1i} s_{1ij} + \beta_{2i} s_{2ij} + ... + \beta_{Ki} s_{Kij} + \varepsilon_{ij} \quad (2)$$

In a standard logit specification, all parameter coefficients are fixed. A random parameter model, as we applied, allows for variations in personal tastes. Normal distributions are assumed for all non-price attributes (zone width, contract length, contract cancelling, fertiliser use, and free assistance) as well as the ASC (see also Goett *et al.* 2000, Revelt & Train 1998). This means that consumer valuations of these attributes can take positive as well as negative values. In order to measure preferences for the different attributes in the same unit, we estimate the marginal substitutions between non-monetary requirements and the subsidy size. Thereby, *willingness-to-accept* (WTA) individual requirements are obtained. We assumed a constant price parameter, since this allows straight forward calculations of the distribution of WTA.

All attributes except the price are treated as dummy variables and are effect coded. The soft ware package Ngene is used to create the design. It is optimized with respect to C-efficent estimations of main effects given the restriction of 8 choice sets to each farmer and no blocks (http://choice-metrics.com/). A random parameter error correction model is estimated using Biogeme (Bierlaire, 2003).

The alternative specific constant (ASC) is just statistically significant at a 5 % level. The positive sign of the ASC indicates that there are some variables that are not captured in the model that induce farmers to prefer not to join any of the offered subsidy schemes. These omitted variables might include other types of requirements that are more attractive (or more attractive levels of the existing requirements) but they might also reflect a general reluctance to join subsidy schemes. To this end, the ASC can represent the entrance

2.3 Our study - design and implementation

Recent studies have focused on the usefulness of buffer zones to protect the terrestrial biodiversity (Bruus et al. 2008; Navntoft 2009). For more than a decade, subsidy schemes for pesticide free buffer zones along streams and lakes have been offered to Danish farmers in order to safeguard aquatic environment and to avoid leaching of pesticides to the ground water – but with limited success among farmers (Christensen et al 2007; Pedersen et al 2007). As buffer zones along hedgerows are not included in the present regulatory initiatives, the present study serves as useful input to future pesticide policies.

In addition to findings from earlier studies, the specific choices of attributes in the present study are greatly inspired by a survey from spring 2009 sent to the same farmers. In that survey, farmers were asked about the importance of a range of factors related to subsidy schemes for reducing environmental effects of pesticide use. The amount of paper work was the factor that the largest number of farmers categorized as very important – a total of 50 % indicated that it was very important for a decision to participate. Uncertainty about being forced into permanent agreements was categorized as very important by 47 % of the respondents, and 43 % of the farmers found it very important that a subsidy would cover more than direct costs. Also of importance – but less so – was the degree to which the farmers ability to plan his field management was restricted (30 % stated that as very important) and the effect on the environment (23 % thought this was very important).

Inspired by these results, we used a focus group to test specific formulations of attributes that the group found meaningful and at the same time politically realistic. An overview of the attributes used in the choice experiment is provided in Table 2. Contract flexibility was captured by including different contract lengths and by introducing an ability to cancel a contract. Description of the administrative burden caused some initial problems as it was not possible to find hourly estimates that were meaningful across farmers. Instead the possibility to be released from the administrative burden by obtaining assistance from the extension service was found to be a satisfactory indicator of the how much weight a farmer would place on the administrative burden. In Denmark, the majority of farmers use the agricultural extension service for economic and field management advices as well as for applying for direct payment under the CAP. Hence, the transaction costs involved in contacting an agricultural advisor for assistance for applying for an additional subsidy scheme are expected to be low. Variation in how much scheme requirements would limit actual field management was captured by introducing an attribute where artificial fertilizer might/might not be allowed in the pesticide free buffer zone. The policy importance of this attribute lies in the differences in environmental and economic effects of buffer zones depending on whether the buffer zones are 'only' pesticide free or whether they are also free from artificial fertilizer. Finally, the size of payments ranged from 1000 DDK (which is the present level that was considered to be a lower bound due to the limited uptake) to 3800 DDK which was identified in the focus groups and in addition was similar to the hectare premium used for establishing wetlands which has been a much larger success than other subsidy schemes).

The six attributes are grouped into three overall categories. *Flexibility in contract terms* are represented by the attributes contract length and the option to be released from the contract. Restrictions on pesticides/fertilizers in the buffer zones, buffer zones width, and assistance with the practicalities of the application process all concern the degree of *flexibility in practical management*, and the size of the subsidy constitutes the *economic incentive* to join the subsidy scheme (the first column in Table 2).

Table 2. Overview over possible requirements in the subsidy schemes used in the choice experiment

Type of requirement	**Scheme requirement (attribute)**	**Detailed scheme requirement (attribute level)**
Flexibility in contract terms	Contract length	- 1 year **- 5 years**
	Cancel option	-contract can be cancelled without costs once a year **-contract cannot be cancelled**
Flexibility in practical management	Buffer zone width	**- 6 meter** - between 6 and 24 meter (possibly the width of your mover)
	Changed agricultural practice	- pesticides cannot be used in buffer zones **-pesticides or artificial manure cannot be used in buffer zones**
	Free assistance for application	**- application for subsidy on common application form** - free assistance from extension service to send in application form
Economic incentive	Size of subsidy (DKK per hectare per year)	1000 DKK, 1700 DKK, 2500 DKK, 3800 DKK

Note: Attribute levels in bold are used as reference levels in the econometric estimations

Table 2 together with a short introduction was presented to the respondents. The text explained the benefits to nature of buffer zones and that the subsidy schemes should be considered as independent and not covered by cross compliance. Each respondent was asked to complete 8 choice tasks. The precise text and an example of a choice situation are presented in appendix.

3. Results

3.1 Descriptive statistics

The survey was carried out in December 2009 and January 2010 within the Nielsen Company's farmer web panel. A total of 486 responses were obtained (response rate of 45 %). Of these, 42 respondents were eliminated from the econometric analysis (see below) while the remaining 444 respondents (totalling 3552 observations) were used in the estimations.

We report the most relevant descriptive statistics. Alternative A was chosen 1414 times, alternative B was chosen 1313 times and none of these was chosen 825 times corresponding to 22 % of the times. In order to eliminate potential protesters[3], we identified the group of farmers who choose none of these in all 8 choice situations. Out of these, 42 respondents chose none of these every time because they partly or completely agreed that subsidy schemes have nothing to do with real farming. Responses from farmers who consequently choose none of these because they thought that the offered subsidy schemes were too unattractive or they were too alike were kept in the data set. With respect to representativeness, there is an overweight of younger farmers and large farms.

A question concerning earlier participation in subsidy schemes revealed that 9 % of the respondents had previous experience which corresponds reasonably well with the actual uptake of existing subsidy schemes. Around 25 % of the farmers indicated that they do not have hedgerows on their farms which leave 75 % of the farms to be pre-qualified for the proposed subsidy schemes. The farmers' perceptions of subsidy schemes as elicited in the questionnaire indicate that there was an overweight of farmers who did not find subsidy schemes an easily obtained income and that a great deal of uncertainty about the consequences of enrolling in subsidy schemes was present among farmers (see Table 3). Also, information concerning the farmers' perceived experiences with AES was elicited. The population was very evenly distributed in their reaction to the statement 'My overall experiences with subsidy schemes is bad', as 29 % partly or completely agreed, 25 % partly or completely disagreed and 39 % answered that they were ´neutral´. Also an even distribution of farmers who believed that participating in an AES is an easy way to assistance the environment was observed. With respect to the statement 'participating in subsidy schemes is an easy way to earn money' an overweight of farmers who disagree (36 %) compared to agree (20 %) was found. Stronger feelings to the statement 'It is difficult to identify how various subsidy schemes affect each other' were observed in that 63 % of the respondents agreed that it was difficult to identify. Also a clear reaction was seen to the statement 'I am uncertain about the consequences for my direct payments (cross compliance) where 44 % partly or completely agreed that they were uncertain about the consequences against 19 % who partly or completely disagreed. Finally, 32 % of the respondents stated that they do not trust the authorities.

Table 3. Distribution of farmers perceptions of subsidy schemes, measured in % of 486 farmers

Please state to what extent you agree or disagree with the following statements.	1 -completely disagree	2 – partly disagree	3- neutral	4- partly agree	5- completely agree	dk
My experiences with subsidy schemes are bad	5	20	39	20	9	7
It is an easy way to do assistance the environment	8	20	35	23	6	8
It is an easy way to earn money	14	22	36	15	5	8
It is difficult to identify how various subsidy schemes affect each other	1	7	16	43	20	5
I am uncertain about the consequences for my direct payments (cross-compliance)	6	13	28	30	14	8
I do not trust the authorities	8	17	39	20	12	5

[3] We defined protesters as respondents who we expected chose none of these without considering the actual offers made by the hypothetical subsidy schemes

3.2 Estimation results

The econometric estimations indicate that all scheme requirements that are investigated significantly affect the farmers' utility. More specifically, flexible zone widths are preferred to a 6 meter zone and 1-year contracts are preferred to 5-year contracts. Also, positive values are attached to the option to cancel a contract without costs, to be able to use fertilizer in the buffer zone and to obtain assistance in the practical application process. And as expected, higher subsidies are valued positively. The results are shown in Table 4. An 'adjusted $\rho^2 = 0{,}26$' suggests that the model fit is indeed acceptable – typically, anything above 0.2 is considered as a good fit (Domencich & McFadden 1975; Louviere et al. 2000).

Table 4. Farmer WTA specific scheme requirements for implementing pesticide free buffer zones (N=444)

Mean values for attribute parameters	Coefficient	Robust Std err	p-value	DKK/ha/ year
Buffer zone width (flexible relative to 6m)	0,179	0,046	0	328
Contract period (1 year relative to 5 years)	0,484	0,047	0	888
Option to cancel contract without costs (once a year)	0,498	0,052	0	914
Permission to use artificial fertilizer in the buffer zone	0,321	0,06	0	589
Application method (assistance relative to common application)	0,215	0,05	0	394
Size of subsidy	0,00109	7,18E-05	0	
ASC (alternative specific constant)	0,558	0,291	0,05	512
Standard deviations of attribute parameters				
Buffer zone width (flexible relative to 6m)	0,407	0,06	0	747
Contract period (1 year relative to 5 years)	0,495	0,05	0	908
Option to cancel contract without costs (once a year)	0,464	0,09	0	851
Permission to use artificial fertilizer in the buffer zone	0,953	0,079	0	1740
Application method (assistance relative to common application)	0,463	0,07	0	850
Size of subsidy	3,6	0,254	0	3303
Adjusted ρ^2	0,267			

Note: All coefficients are normally distributed except size of subsidy which is fixed. All variables are effect coded. Therefore, all coefficients in the table are multiplied by 2 before division with price-coefficient for obtaining WTA. 1000 Halton draws are used.

A ranking of the individual requirements reveals a clustering in levels of importance. Flexibilities in contract specifications are the most important characteristics. This group includes the possibility to cancel the contract as well as short contract length. The second group involves utility of flexibility in the practical aspects of the contract such as whether fertilizer is allowed, zone width and the amount of administration involved in the actual application procedure.

All attributes except the price, can assume two levels. No absolute parameter values are estimated, only the increased value of facing a certain subsidy scheme relative to a reference scheme is identified. For example, the estimated value of facing flexible zone width instead of 6 meter zones is 328 DKK/ha/year for an average farmer. Large and significant standard deviations of the normally distributed coefficients indicate that there is a great deal of heterogeneity in valuations across farmers. As mentioned, the average value of a flexible zone width is 328 DKK/ha/year with a standard deviation of 747 DKK/ha/year.

The alternative specific constant (ASC) is just statistically significant at a 5 % level. The positive sign of the ASC indicates that there are some variables that are not captured in the model that induce farmers to prefer not to join any of the offered subsidy schemes, see Adomowicz et al.(1998) and Meyerhoff & Liebe (2009). These omitted variables might include other types of requirements that are more attractive (or more attractive levels of the existing requirements) but they might also reflect a general reluctance to join subsidy schemes. To this end, the ASC can represent the entrance value needed to make farmers interested in joining a subsidy scheme as described in the choice experiment. This is, to our knowledge, the first attempt to quantify the entrance value that seems to be needed to overcome non-economic barriers. Note however, that the large heterogeneity across farmers complicates the interpretation of ASC as a common entrance value.

We tested for heterogeneity in mean with respect to farm size (whether farms with more than 200 hectares which involves 21 % of the sample behaved differently) and earlier participation (whether farmers who participated in an AES in 2009 behaved differently than those who had not – involving 9 % of the sample).

4. Discussion and conclusion

The farmers' perceptions of subsidy schemes as elicited in the questionnaire help to understand some of the barriers that need to be overcome in order to increase their interest in subsidy schemes. First, our results suggest that one third of the Danish farmers did not find subsidy schemes an easy source of income. This matches the findings in Mettepenningen et al. (2009) p. 659, where 67 % of the respondents stated that the total costs incurred by AES exceeded the compensation payment. Second, there is a great deal of uncertainty among farmers about the consequences of enrolling in subsidy schemes with respect to the degree of overlap with other subsidy schemes, to what extent cross compliance will be used and there is a considerable lack of trust in authorities. These are fundamental barriers for increasing farmers' interest in AES and they need to be addressed if further uptake is to be expected.

We used the value that farmers place on obtaining assistance free of charge from the extension service to approximate their perceived costs of the administrative burden related to the application procedure. The results are promising in the sense that farmers attached a positive value to be released from the administrative burden and increasing the communication between farmers and the extension service might even be a way to reduce some of the above mentioned barriers related to uncertainty among farmers about the consequences of enrolling in subsidy schemes.

In the current agricultural policy, most AES are part of the cross compliance system which means that not fulfilling the requirements in the voluntary agreement can be very costly for the farmer. This suggests that farmers' reluctance to joining subsidy schemes are not directly related to the payments of the subsidy scheme in question but to their overall direct payments. The risk of being caught in a cross compliance control seems to be a real barrier which needs to be addressed if AES are to be used in future environmental policy instruments. On one side, cross compliance increases farmers' incentives for complying but it certainly also reduces farmers desire to join subsidy schemes.

The choice experiment indicated that farmers are indeed able to rank individual requirements in a subsidy scheme and to trade off requirements against the amount of subsidy. From a policy point of view, these results are promising as they suggest that farmers might be made interested in implementing buffer zones by offering them something else than simply higher payments. Note however, that 42 farmers consistently choose none of these which is a clear indication that these farmers will be very difficult to motivate to enrol in subsidy schemes.

Generally, we found that flexibility is the keyword for catching farmers' interest in subsidy scheme which supports findings by Wynn et al. (2001) and are also found recently in Ruto & Garrod (2009). More specifically, we found that overall flexibility of the contract (contract length and ability to cancel the contract) seemed to be more important than the actual practical restrictions in flexibility that the contracts

induced (whether fertilizer could be used in the buffer zone, buffer zone width and practical assistance in the application process).

Due to the case-oriented approach, the robustness of these interpretations needs to be addressed. For example, the results indicate that when contract length varies between 1 and 5 years, then it is more valuable to sign up for short-termed contracts than for long-termed. Whether similar result holds when comparing 1 and 2 year contracts or 10 and 20 year contracts in this particular case requires further analyses but earlier findings confirm that shorter contracts are generally preferred to longer.

Regardless whether the buffer zones are going to be implemented as part of a voluntary agreement or as a compulsory regulatory tool, our findings provide valuable information. It almost goes without saying, that in a voluntary context, it is important for the success of the subsidy schemes that they are made as attractive to the farmers as possible provided that the environmental goals and environmental budgets are met. Looking at compulsory buffer zones (or other requirements), the success in terms of compliance (and necessary payments) depends greatly on designing the requirements such that the alternative costs to the farmers are as small as possible – this will also reduce the need for monitoring and control.

In the choice experiment we focused on how farmers valued the agreements. However, in order to evaluate the efficiency of agreements, we need also to assess the impacts on the environment. We found that farmers attached different costs to the requirements - but the environmental effects do also differ. The overall picture is that the more hectares that are farmed in an environmentally friendly way and the longer time pesticides and fertilizers are not used, the larger are the environmental benefits. To this end, the present approach to assess farmers' preferences opens up for not only identifying trade off's between payments and individual requirements but also for identifying environmental consequences of the individual requirements. For example, if the average farmer needs to be paid 888 DKK for enrolling in a 5 year contracts compared to a 1 year contract, will the environmental value of this extension of the contract exceed the costs? This requires valuation of the environmental benefits which is subject for further research – but the contribution of the choice experiment method is that it is meaningful to ask the question – and eventually, answer it too.

References

Adamowicz, W. L.; Boxall, P.; Williams, M. & Louviere, J. (1998): Stated Preference Approaches for Measuring Passive Use Values: Choice Experiments and Contingent Valuation, *American Journal of Agricultural Economics*, 80: pp. 64-75.

Bateman, I.J., Diamond, E., Langford, I.H., Jones, A. (1996): Household willingness to Pay and Farmers' Willingness to Accept Compensation for Establishing a Recreational Woodland, *Journal of Environmental Planning and Management*, 39 (1): 21-44.

Bierlaire, M. (2003). BIOGEME: A free package for the estimation of discrete choice models, *Proceedings of the 3rd Swiss Transportation Research Conference*, Ascona, Switzerland.

Birol, E., Smale, M., Gyovai, Á. (2006): Using a Choice Experiment to Estimate Farmers' Valuation of Agrobiodiversity on Hungarian Small Farms, *Environmental & Resource Economics*, 34(4): 439-469, August.

Bruus, M., Strandberg, B., Kjær, C., Løfstrøm, P., Andersen, H.V. (2008). Herbicide drift into hedgerows: Extent, effects and mitigation. *SETAC Europe 18th Annual Meeting*, Polen.

Burton, R.J.F., Kuczera, C., Schwarz, G., 2008. Exploring Farmers' Cultural Resistance to Voluntary Agri-environmental Schemes. *Sociologia Ruralis* 48(1): 16-37.

Christensen, T., H. Ø. Nielsen & A. Branth Pedersen (2007). Effektivitet af virkemidler i pesticidpolitikken. Notat i projektet EUs landbrugsordninger og pesticidpolitikken, Miljøstyrelsen & DMU.

DeFrancesco, E., Gatto, P., Runge, F. & Trestini, S. (2007). Factors affecting farmers' participation in agri-environmental measures: A northern Italian perspective. *Journal of Agricultural Economics*, 59: 114-131.

Domencich & McFadden (1975).

Ducos, G., Dupraz, P & Bonnieoux, F. (2009). Agri-environment contract adoption under fixed and variable compliance costs. *Journal of Environmental Planning and Management*, 52 (5): 669-687.

Economic Council (2010). Economy and the environment. Chapter 1: Agriculture.Eocnomic Council, Copenhagen. http://www.dors.dk/graphics/Synkron-Library/Publikationer/Rapporter/Milj%F8_2010/Disk/Summary%20M10%20first%20draft_22032010.pdf
Environmental Protection Agency 2000, *Bekæmpelsesmiddelstatistik 1999,* Copenhagen.
Environmental Protection Agency 2003, *Bekæmpelsesmiddelstatistik 2002*, Copenhagen.
Environmental Protection Agency 2006, *Bekæmpelsesmiddelstatistik 2005*, Copenhagen.
Environmental Protection Agency 2009, *Bekæmpelsesmiddelstatistik 2008 – Revideret 11. september 2009*, Copenhagen.
Epinosa-Goded, M., Barreiro-Hurlé, J. & Ruto, E. (2010). What do farmers want from agri-environmental scheme design? A choice experiment approach. *Journal of Agricultural economics*, 61 (2): 259-273.
Falconer, K. (2000). Farm-level constraints on AES participation: A transnational perspective. *Journal of Rural Studies*.16: 379-394.
Freier, B. & E.F. Boller (2009). Integrated Pest Management in Europe – History, Policy, Achievements and Implementation. pp.435-454 in R. Peshin & A.K. Dhawan, *Integrated Pest Management: Dissemination and Impact*, Springer.
Garrod, G. (2009). Greening of the CAP: How the improved design and implementation of agri-environment schemes can enhance the delivery of environmental services. Jou*rnal of Environmental Planning and Management*, 52 (5): 571-574.
Gasson, R, 1973. Goals and values of farmers. *Journal of Agricultural Economics*, 24:.521-42.
Gravelle, H. & Rees, R. (1992): *Microeconomics* 2nd edn, Pearson Education Ltd., Harlow, England.
Lancaster, K. J. (1966): A New Approach to Consumer Theory, *The Journal of Political Economy*, 74 (2): 32-157.
Louviere, J.; Hensher, D. A. & Swait, J. (2000): *Stated Choice Methods. Analysis and Applications* University Press, Cambridge, UK.
Luce, R. D. (1959): *Individual choice behaviour* Wiley, New York.
McFadden, D. (1974): Conditional Logit Analysis of Qualitative Choice Behavior In: *Frontiers in Econometrics*, P. Zarembka, ed., (eds.) (1974): Academic, New York, pp. 105-142.
Mettepenningen, E., et al (2007), Analysis of private transaction costs related to AES – ITAES WP6 consolidated report (EU FP6, ITAES deliverable no.15).
Mettepenningen, E., Verspecht, A. & Van Huylenbroeck, G. (2009). Measuring private transaction costs of European AES. *Journal of Environmental Planning and Management*, 52 (5): 649-667.
Meyerhoff, J. & Liebe, U. (2009): Status Quo Effect in Choice Experiments: Empirical Evidence on Attitudes and Choice Task Complexity, *Land Economics*, vol. 85, no. 3, pp. 515-528.
Ministry of Environment & Ministry of Food, Agriculture and Fisheries (2003). *Pesticide Action Plan II. March 2000.* Ministry of Environment & Ministry of Food, Agriculture and Fisheries.
Navntoft, S., Sigsgaard, L., Nimgaard, R., Esbjerg, P. Kristensen, K., Andresen L.C. & Johnsen, I. (2009). Buffer zones for biodiversity of plants and arthropods: Is there a compromise on width? Report 127. Miljøstyrelsen.
Nielsen, H. Ø., (2010). *Bounded rationality in decision making, How cognitive shortcuts and professional values may interfere with market-based regulation*. Manchester University Press.
Pedersen, A. Branth, H.Ø. Nielsen & T. Christensen (2007). Muligheder og barrierer på kort sigt i EU's landbrugsordninger. Notat i projektet EUs landbrugsordninger og pesticidpolitikken, Miljøstyrelsen & DMU.
Ruto, E. & G. Garrod (2009). Investigating farmers' preferences for the design of agri-environment schemes: a choice experiment approach. *Journal of Environmental Planning and Management*, 52 (5): 631-647.
Siebert, R. , Toogood, M. & Knierim, A. (2006). Factors affecting European farmers' participation in biodiversity policies. *Sociologia ruralis*, 46: 319-340.
Vanslembrouck, I., van Huylenbroeck, G. & Verbeke, W. (2002). Determinants of the willingness of Belgian farmers to participate in agri-environmental measures. *Journal of agricultural economics*, 53: 489-511.
Wynn, G., Crabtree, B. & Potts, J. (2001). Modelling farmer entry into the environmentally sensitive area schemes in Scotland. *Journal of agricultural economics*, 52: 65-82

Appendix

The following text was used as introduction to the choice experiment.

New subsidy schemes are offered for implementing buffer zones along hedgerows. Buffer zones along hedgerows provide space for flowering herbs and insects – and provide food for (among others) grey partridges and hares. It is important for the positive effects on the nature that the buffer zones are cut every year in late august. The buffer zone area is entitled to direct payments. The new subsidy scheme is not covered by cross compliance. Therefore, the size of the payments can be considered independently from the direct payments. The new subsidy schemes differ from each other with respect to the following six characteristics. On the next page, we show you a table that provides an overview of the subsidy schemes you will be confronted with.

Figure 1: An example of a choice set

	Subsidy scheme A	**Subsidy scheme B**
Buffer zone width	6 m	Flexible width (between 6 and 24 m)
Contract length	1 year	5 years
Option to cancel contract (without costs)	Yes	No
Krav til ændret praksis i randzonen	Pesticide free	Pesticide free
Application method	Usual application procedure	Free assistance
Size of subsidy	2500 DDK	1700 DDK

Which of the subsidy schemes do you prefer?

□ Subsidy scheme A
□ Subsidy scheme B
□ None of these